of society, the "stagnant" masses as he would call them. From this stratum emerge the men of energy so dear to Mr. Wells's heart. Occasionally the son of a poor man, say in Scotland or Yorkshire, rises to eminence. Far more often it takes more than one generation to climb the ladder. But this does not alter the fact that this substratum is an absolute necessity. For the upper strata do not keep up their numbers, and society has been truly described as an organism that is perpetually renewing itself from its base. But Mr. Wells knows only of the abyss into which tumble all the failures of modern life. Such a valuable national asset as peasant land-holders he despises and wishes to abolish. Yet from such "stagnant" classes spring the families that work upward and produce the men of energy that do the highest work of the nation. The downward movement of which Mr. Wells talks so much is comparatively but a puny stream. No doubt there is an abyss, no doubt there are in our big towns not a few degraded families which are tending to die out. Yet even the most degraded produce here and there a man of grit, a man, for instance, who enlists and rises to be a non-commissioned officer. The pick of the slum-bred men make fine fighters.

Mr. Wells wishes all citizens to be energetic and up to date. The unadaptable masses must be got rid of. They must be instructed so that the indulgence of their sexual instincts may not lead to their having offspring. Reckless parentage must be in every way discouraged. And yet Mr. Wells declares that he cannot devise any system of selection by which it would be possible to breed good citizens; the qualities demanded are too diverse. So we are to get rid of the reckless classes and depend solely on the careful classes. We are to introduce careful parentage, that is, put a stop to natural selection; but there is to be no scientific selection to take its place. The result would indeed be disastrous. As it is, our national physique may be poor, but what there is in the nation of physical vigour is due to the great amount of elimination, probably not far short of 50 per cent., that still goes on.

Here is another strange forecast. War is "the most educational of all masters," and yet after many years a great world state will arise and there will be a kind of millennium. If war the great educator, the great antiseptic, is no more, surely the world is likely to be the worse for its absence. What is to make the world better? No doubt Mr. Wells would say, "The advance of science." Science is his sheet anchor. It is to ennoble the national life so that even the idle holders of irresponsible wealth will be powerless to degrade it. But will this be so? No doubt the inventor is ennobled by his brain labour, by his striving to make his dream a reality. And the men of energy who find practical applications of his discoveries are doing work of a kind that often, though not always, elevates the character. But what of the people who merely make use of the discoveries and inventions of others? The man who invents a locomotive engine is likely, at the lowest, to be above the pettiest meannesses. But the mere travelling in railway trains leaves men morally no better and no worse. The striving after knowledge is the ennobling thing, and not the knowledge itself, the making of discoveries. not the enjoyment of them.

This being so, there is a fallacy running all through that very humorous romance "The Food of the Gods"; in the story those who are fed on this food in their infancy and youth grow to a height of some forty feet. The inventors do not add to their inches. In its application this is not true. The mass of mankind remain small in brain and character—they grow, but do not grow much, when their youth is nurtured on the clearest and noblest ideas. The few thinkers discoverers, inventors are the giants. As to education, Mr. Wells has much to say that is worth pondering. He wishes boys to make a real study of the English language and literature. On our success in teaching English and producing good literature depends the answer to the question: Will English retreat before the tongue of some rival synthesis, or will it become the language of the world? For educational purposes, the dead languages, as we might expect, are tried and found wanting. Those who teach them are "fumbling with the keys at the door of a room that was ransacked long ago." F. W. H.

BRITISH FRESHWATER ALGÆ.

A Treatise on the British Freshwater Algae. By Prof. G. S. West. Pp. xv+372. (Cambridge: At the University Press, 1904.) Price 10*s.* 6*d.* net.

A Monograph of the British Desmidiaceae. Vol. i. By W. West and Prof. G. S. West. Pp. xxxvi+224. (London: Printed for the Ray Society, 1904.) Price 25*s.* net.

WHOEVER has sought to gain a practical knowledge of the British freshwater Algæ has in the past been often checked by the impossibility of determining, by the aid of English works, many of the forms met with. During the twenty years that have elapsed since the issue of the latest large English work on the group (Cooke's "British Freshwater Algæ") very great progress has been made in most countries of Europe, in North America, and to some extent in other countries also, in the study of these plants. Very many species previously unknown have been detected, and much light has been thrown on obscure life-histories, on the effects of environment, and on the relationships of the various Algæ to one another, and to other organisms of simple structure. But while so much new knowledge has been gained, it is dispersed in various languages and in numerous volumes; and there has been, in English, no trustworthy guide even to the published results of these years dealing with the British freshwater Algæ. Thus it has become more and more difficult to pursue the study with success, and the need of adequate presentation of the subject has been felt to be very urgent. The works just issued by the Messrs. West are most welcome, and mark a very great advance on earlier books in English dealing with these Algæ. The authors possess a unique knowledge of the species and of their distribution in Britain, the result of personal investigations carried on unweariedly in many and varied districts of the British Islands. They have

added largely to previous records in species new to science, in others new to British lists, and in the fuller knowledge of the life-histories of species already known. The task was no easy one, but none more competent could have undertaken it, and it has been accomplished in a way to deserve the gratitude of all interested in the freshwater Algæ of Great Britain and Ireland.

The "Treatise" is one of the well known and excellent Cambridge Biological Series. Its aim is stated as "to give the student a concise account of the structure, habits and life-histories of Freshwater Algæ, and also to enable him to place within the prescribed limits of a genus any Alga he may find in the freshwaters of the British Islands." To do this within the limits of an octavo volume of less than 400 pages, in which are numerous illustrations, is a task possible of accomplishment only by one very familiar with the subject and skilled in concise expression; but that it has been successfully done will, we think, be the verdict after testing the book thoroughly. The views and labours of others receive due attention, and footnotes direct the student to the original publications; but Prof. West is no mere follower of the views of others, and much of the excellence of his book is due to his personal researches and to the conclusions he has drawn from them. In the preface we read that "there is no single book, or accessible set of books, by means of which a student can hope to accurately identify one-third of the freshwater Algæ he may find in a single day's ramble through a reasonably productive part of the country." With the aid of this guide he may hope to determine the genus of all save the more critical forms, and even the species in some of the genera. But the book is much more than a guide to the identification of genera and species. The introduction gives a very readable and interesting general account of freshwater Algæ in respect of their habitats, distribution, relations to and associations with certain other plants, and even with the lower animals, some of these correlations being of very curious kinds. Their relations to temperature (some thriving on ice and snow, while others can live around hot springs at 94°·5 C.), to surface conditions and exposure, and to geological strata are discussed; and the author's wide experience in field work gives much interest to the discussion. Mountainous districts are the richer, especially in Myxophyceæ and Conjugatæ, of which latter the desmids and Mougeotia are peculiarly numerous in species in these regions. The older Palæozoic and Igneous regions are preeminent in this respect, and the richest localities in Britain, "and perhaps in the whole of Europe," are tarns and peat-bogs in hollows of the Lewisian gneiss of north-west Scotland, while the fen district of eastern England is the poorest in Britain in freshwater species of Algæ.

The methods of collection, of cultivation (so important as a means of study), and of preservation for future use are described. The structure, cell-contents, nutrition and growth of the cells and plant-bodies, the methods of multiplication by division and of reproduction (asexual and sexual), the alternation of generations, the range of polymorphism observed in some species, and alleged to occur in others, are considered, and the belief is stated that the higher types have originated by gradual evolution from the more lowly types, but that the latter still persist, and must not be confounded with stages in the life-histories of the higher forms, as the author believes has been done by some. The phylogeny and scheme of classification take full note of the discoveries and views of Blackman, Bohlin, Borzi, Chodat, Wille and others, combined with the author's own discoveries.

Six great classes are recognised, of which four (Rhodophyceæ, Phæophyceæ, Bacillariaceæ or diatoms, and Myxophyceæ) are of the usual compass, the two former including few species in fresh waters. The Heterokontæ, a group proposed a few years ago by Luther for a few families characterised by yellowish-green chromatophores and the production of oil as a reserve of food, are separated off from the other green Algæ; but all the remaining green types are included in the class Chlorophyceæ, the methods of reproduction not being accepted as justifying their separation into different classes. Chlamydomonas is regarded as nearest to the origin from which all have sprung, scarcely different from the Flagellata, and the divergent lines of increasing complexity are traced, three chief tendencies, as pointed out by Blackman, showing themselves, and resulting in three types of structure, viz. the motile cœnobium, the multinucleate unicellular cœnocyte, and the multicellular aggregate, the cells of which become more and more intimately related and specialised to form the definite organism. This last type has resulted in the most complex structures among Algæ, and is regarded as having given origin through them to the archegoniate plants.

All grades of classification of the British freshwater Algæ down to genera are defined in this "Treatise," and each genus is well illustrated by drawings from the plants themselves, with few exceptions original. The number of British species is stated under each genus, and information is often added regarding the more representative species. For each genus also the synonymy is given, along with references to the literature.

Prof. West's treatment of his subject is instructive and stimulating, and the book will do much to extend the study of these plants. But it also excites the hope that he will supplement this work by giving us one descriptive of all the species and varieties of these Algæ that have been found in Britain, with, if practicable, indications of those likely to be added to the flora. He has pointed out the need of such a guide, and has proved that it could be attempted by none more fit to make it a success.

The volume on "British Desmidiaceæ" also illustrates the extraordinary advance in the study of British freshwater Algæ in recent years, due to the researches of but a few workers, among whom the authors are in the front rank. In this monograph will be brought together not only much information that, though published, was often scarcely accessible, but also much acquired through researches in many regions, from Shetland to Cornwall, in Wales and Ireland, and not yet published. Nearly 700 species and 450 varieties are now known from the British Islands (being rather more than one-third of all named species). Of these

many have been discovered and made known by the authors. Cooke's "British Desmids," issued in 1886–7 as a compilation of all the forms then known, included less than 300 species and less than 50 varieties. In this first volume rather more than one-fifth of the British species and varieties are included, so that the "Monograph" will probably extend to five volumes.

Each form is described, with references to its synonyms and its bibliography; and its distribution in the British Islands is detailed, the authority for each locality being stated. The figures are original, except where it was not possible to procure specimens. When borrowed the sources are always acknowledged. A very full list of books and papers on desmids adds to the value of the work.

The "Monograph of British Desmidiaceæ" is worthy of a place among the numerous valuable works issued by the Ray Society, and will be indispensable in the study of these plants.

THEORY OF RAPID MOTION IN A COMPRESSIBLE FLUID.

Leçons sur la Propagation des Ondes et les Equations de l'Hydrodynamique. By Jacques Hadamard. Pp. xiii+375. (Paris: Hermann, 1903.) Price 18 francs.

THE theory of fluid motion, as ordinarily worked out, presents several *lacunae*. One notable omission is the absence of any detailed discussion of the effects of compression and rarefaction of air owing to the rapid motion of bodies through it. An artillerist, seeking by the aid of the theory for principles that would help him to understand the resistance of the air to the motion of projectiles, would be likely to be disappointed. He would find an explanation of the effect of rifling in keeping the points of projectiles forward; but, while he might admire the ingenuity displayed in the development of the theory, he would feel that, with this exception, it shed but little light upon his business. The present book represents the outcome of efforts made in recent years by some French mathematicians, and especially by Hugoniot and P. Duhem, to widen the scope of the traditional hydrodynamics so as to include rapid motions in compressible fluids.

Our hypothetical artillerist would need to exercise much patience in order to get on with the book. He would probably soon give it up as too intensely mathematical. The first chapter is devoted to an account of an existence theorem in the theory of potential. It is to be proved that, provided a certain condition is satisfied, there exists a function which is harmonic in a given region and has a given normal rate of variation at the boundary of the region, in other words, that irrotational motion of incompressible fluid is possible within a closed surface which changes its form in a prescribed manner without changing its volume. The author gives a proof which is very interesting from the point of view of analysis. He also expresses the required function by means of a subsidiary function which he calls "Fonction de Franz Neumann," and of another which he calls "Fonction de Klein." The latter is the velocity potential due to a source and a sink within the given surface, and the former also can be interpreted physically, but the interpretations are not recorded. In the case of a spherical boundary, which is worked out, the results are attributed to Bjerknes and Beltrami. It would seem that these writers, therefore, virtually anticipated Hicks's discovery of the image of a source with respect to a sphere. One misses the interpretation in terms of images. The mathematics is there, but the author does not tell us what it means. Nevertheless the mathematics is excellent.

In chapters ii. and iii. we have so much of the ordinary theory as is requisite for the purpose of setting out the equations and conditions which govern the motions of fluids, and we have also an extension to discontinuous motions. The fact that was emphasised by Hugoniot is that the motion is not necessarily continuous. He paid especial attention to the case in which the velocity is everywhere continuous, but the differential coefficients of the components of velocity are discontinuous at a moving surface. The discontinuities at such a surface are not arbitrary, but are subject to three sorts of conditions. The surface moves through the fluid like a wave. One set of conditions connects the discontinuities with the direction of the normal to the surface. A second set connects them with the velocity of propagation. These two sets of conditions are kinematical. To determine the velocity of propagation the dynamical equations must be introduced. The kinematical conditions are called "conditions d'identité" and "conditions de compatibilité," and they are expressed by means of some elegant geometry. The necessity for such conditions has been recognised by other writers in the case of discontinuities that affect the velocity. The latter are here called "waves of the first order." The origin of Hugoniot's discontinuities, called "waves of the second order," is found in an analytical paradox. If the pressure is a function of the density, the equations of motion determine the acceleration of every particle; but, if the motion of a boundary is prescribed, the normal component of the acceleration of the particles that are in contact with the boundary is prescribed also. The two values thus obtained for this acceleration are in general different. Waves of the second order originate at the boundary, and are propagated through the fluid.

Chapter iv. deals with rectilinear motion in a gas, and is mainly occupied with the problem, first attacked by Riemann, of discontinuities that affect the velocity. Riemann's theory was condemned by Lord Rayleigh on the ground that it violated the principle of energy, and the problem remained in an unsatisfactory state for many years. It was taken up again by Hugoniot in 1887 without knowledge of Riemann's work. Hugoniot introduced expressly the condition that the increment of energy—kinetic and internal—of the portion of fluid which undergoes a sudden change of state is equal to the work done upon it by the pressures of neighbouring portions, and he concluded that the law connecting pressure and density ($p=\kappa\rho^{\gamma}$) cannot be maintained during the passage of the dis-